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ABSTRACT

Many school districts experience difficulties attracting and retaining teachers, and schools in urban areas serving economically disadvantaged and minority students appear particularly vulnerable to these problems. This paper investigates factors that affect the probabilities that teachers will switch schools or exit the public schools entirely. Researchers used matched student/teacher panel data on Texas public elementary schools to gain a better understanding of the effects of salary and other school factors on teacher transitions. These data permitted a detailed description of student demographic and school characteristics and pre- and post-move comparisons for teachers who switched schools within Texas or left the Texas public schools. Teachers were divided by experience, school community type, ethnicity and other factors so researchers could examine differences in the responsiveness to salary and student characteristics on the basis of teacher experience, race, and ethnicity. Results indicate that teacher mobility is much more strongly related to characteristics of students, particularly race and achievement, than to salary, although salary exerts a modest impact once compensating differentials are taken into account. Non-black, non Hispanic teachers systematically prefer non-black, non-Hispanic students, while the opposite is true for black and Hispanic teachers. (Contains 56 references.) (SM)

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ABSTRACT

Many school districts experience difficulties attracting and retaining teachers, and the impending retirement of a substantial fraction of public school teachers raises the specter of severe shortages in some public schools. Schools in urban areas serving economically disadvantaged and minority students appear particularly vulnerable. This paper investigates those factors that affect the probabilities that teachers switch schools or exit the public schools entirely. The results indicate that teacher mobility is much more strongly related to characteristics of the students, particularly race and achievement, than to salary, although salary exerts a modest impact once compensating differentials are taken into account.

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Why Public Schools Lose Teachers

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Issues of teacher shortages have pervaded policy discussions for decades. Although the exact nature of the concerns – specific subjects such as math or science, recruiting difficulties in urban centers, or elements of quality such as availability of fully certified teachers – has varied over time and across locations, the perceived need to act has not. In response, educators have offered a variety of compensation policies designed to attract more teachers into the profession and to retain more of those currently teaching. These include higher pay (typically across the board but sometimes targeted on specific communities or subjects), forgiveness on student loans in exchange for a commitment to teach (often in difficult to staff schools), and the expansion of alternative certification and housing reserved for teachers but to name a few. The efficacy of any of these strategies depends crucially on the responsiveness of supply, and, as we demonstrate below, must be evaluated in terms of other powerful forces operating in teacher labor markets.

A basic impediment to the development of effective teacher labor market policies is the lack of a comprehensive understanding of the determinants of teacher labor supply. Teacher labor supply actually aggregates a variety of decisions made at different points in time and based on different information and influences. With some variants, the pre-teaching phase begins with a decision to train for teaching and with successful completion of teacher preparation and certification (or at least enough schooling to qualify for an emergency license). It then moves to the application and job matching process. Having been hired at a particular school, the career path is determined by the continuation and retention decisions of both teachers and schools. This paper focuses on those who have already entered teaching and considers the details of the supply decisions of current teachers.[1] Their transitions relate much more

[1]While many more teachers are certified each year than are needed to fill vacancies, the pre-teaching phase is important for consideration of some specialities such as the current shortages in advanced math and science, in special education, and in bilingual education. The policy discussions in these areas generally concentrate on issues of overall salary levels and of requirements for certification (e.g., Murnane et al., 1991; Hanushek and Pace, 1995).

directly to the circumstances and policies of specific districts and their interaction with teacher preferences.

A number of papers including Murnane and Olsen (1989, 1990) and Dolton and van der Klaauw (1995, 1999) have examined the link between duration in teaching and pay. These studies generally find that higher teacher pay reduces the probability that teachers leave the profession, particularly once differences in alternative earnings opportunities are taken into consideration.

One potential problem for these studies is the limited amount of information on working conditions that may be correlated with salary. While Murnane and Olsen attempt to account for differences in working conditions by including demographic information on school districts from U.S. Census data, the lack of direct information on public school students, availability of only a single year of data on student characteristics and other limitations inhibit the analysis of these factors. Not only does the lack of good information on student and school characteristics (such as class size) potentially bias the estimated effects of salary, it also reduces the understanding of the association between student characteristics and transitions.

We make use of matched student/teacher panel data on Texas public elementary schools to gain a better understanding of the effects of salary and other school factors on teacher transitions. These data permit a detailed description of student demographic and school characteristics and pre- and post-move comparisons for teachers who switch schools within Texas or leave the Texas public schools. Given the large number of teachers and teacher transitions in the data, we can divide teachers on the basis of experience, school community type, ethnicity and other factors and examine differences in the responsiveness to salary and student characteristics on the basis of teacher experience, race and ethnicity.

The results show that teacher transitions are much more strongly related to particular student characteristics than to salary differentials. Schools serving large numbers of academically disadvantaged, black or Hispanic students tend to lose a substantial fraction of teachers each year both to other districts and out of the Texas public schools entirely. An implication is that the supply curve faced by these

districts differs markedly from that faced by middle and upper middle class communities in which a far lower proportion of teachers seek to improve their employment arrangement by switching to another public school.

Determinants of the Supply of Teachers

The standard microeconomic framework for analyzing teacher supply and salaries would began with individual labor supply decisions and aggregate these up to a market supply function. The supply of labor to district d within a geographical area j can be characterized by:

$$q^S_{dj} = f(w_d, WC_d, A_j, O_j)$$

where q^S is the supply of teachers for district d in area j; w_d and WC_d are wages and working conditions, respectively, in district d; and A_j and O_j are amenities and other employment opportunities, respectively, in area j. Consideration of each of these elements allows us to frame the analysis and to put previous work into a more general context.

Salaries (w_d). A fundamentally important issue in the consideration of teacher labor markets is which salary differences to look at and how they should be interpreted.[2] At any point in time, teacher wages will vary within a district. These wage differences reflect different components of teacher salary contracts involving experience, graduate education levels, and a variety of other factors. Observing these wage differences provides information about movements along a supply schedule, but it does not provide information about what would happen if the entire salary schedule were shifted. Much of the analysis of achievement effects of salaries, for example, has considered differences in wages along a salary schedule or combined movements along schedules with changes in the overall salary structure (Hanushek 1997),

[2]Fringe benefits are an important and growing share of compensation, and differences in the generosity of benefits is certainly not perfectly correlated with salary differences. Unfortunately, we, like all past researchers, do not have information on fringe benefits.

while much of the policy debate focuses on the level of the entire salary schedule.[3] By constructing annual salary schedules for single years of experience in each district over only teachers who do not have a graduate degree, we can isolate the effects of both cross-sectional and inter-temporal variations in overall salary levels.[4]

Alternative Earnings Opportunities and Amenities(O_j,A_j). It is long established that one must account for differences in alternative opportunities for teachers. This is clearest in consideration of differential competition for specific teachers, say math and science teachers versus those in other specialities (e.g., Kershaw and McKean 1962; Zarkin 1985; Murnane et al., 1991). It also comes into play in terms of consideration of the districts that form the relevant decision set. If areas differ by prices or amenities or if labor markets are geographically confined, salaries must be considered in comparison to the relevant group of competing districts. This point, made by Chambers (1977) and Ferguson (1991), provides information on the specification of the wage and compensation comparisons. Important elements of the overall market factors are also highlighted in Flyer and Rosen (1997) and Boardman, Darling-Hammond, and Mullin (1982).

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[3]There has also been a substantial amount of discussion about the use of teacher pay as a direct incentive for better performance by individual teachers. See Cohen and Murnane (1986) and Hanushek et al (1994) for discussions of merit pay. There is little evidence of systematic variation in salaries based on performance in Texas schools, although a number of districts have considered such moves.

[4]We have focused on salaries of teachers without post-bacheloriate schooling, because only roughly one fourth of Texas elementary school teachers possess a master=s degree.

The empirical evidence supports the belief that alternative earnings opportunities affect teacher labor supply. In a series of papers, Dolton and van der Klaauw (1995, 1999) and van der Klaaw (1997) investigate the impact of alternative opportunities on teacher transitions. They find evidence that opportunity wages affect the probabilities of both entry and exit. These results are consistent with earlier work by Murnane and Olsen (1989, 1990), which found that opportunity wages affected duration in teaching in both Michigan and North Carolina. In this paper, differences in alternative wage opportunities are accounted for by the inclusion of dummy variables for each Texas Education Agency defined region of Texas and school district fixed effects in some specifications. Because virtually all teachers in our data possess at least a B.A. and teach elementary school age children, additional differences in alternative opportunities such as those considered by Dolton and van der Klaauw should not be very important in this analysis.

Working Conditions (WC_d). Much has been made of the fact that there is more to a teaching job than just the overall salary or compensation levels. Some of the earliest work considered how teacher preferences might affect the selection of schools (Greenberg and McCall 1974; Murnane 1981). More generally, teachers might be willing to take lower salaries to obtain better conditions in their schools, a proposition first found in Antos and Rosen (1975) and subsequently pursued in a variety of other analyses (e.g., Baugh and Stone 1982; Hanushek and Luque 2000). Some have interpreted the push for lower class sizes by teachers as reflecting an element of teacher compensation, as opposed to an educational policy designed to improve student achievement (cf. Grissmer and Kirby 1992).

If differences in working conditions are not accounted for and they are correlated with salaries, estimates of the relationship between teacher transitions and salaries will confound salary influences with those of other factors that affect teacher labor supply. For example, if salaries are higher in urban districts and teachers prefer suburban districts, estimates of teacher salary effects on labor supply confound the impacts of salary and community type unless adequate controls for community type are included. Loeb

and Page (1998) argue that the failure to account for differences in working and labor market conditions explains why many studies fail to identify the true relationship between achievement and salaries.

A central element of the empirical analysis here is the description of movements of teachers across different types of schools and student populations in order to study the preferences of teachers and the form in which compensating wage differentials are played out. Four measures of student characteristics that may be related to teacher labor supply are included: percent low income, percent black, percent Hispanic, and average student achievement score. Whether these specific characteristics directly affect teacher decisions or they serve as proxies for other factors cannot be determined. In any case the estimates will identify those schools that experience the greatest difficulties in teacher labor markets.

Personnel Policies. While the relationship between salaries and employment is observed, it is not possible to infer *a priori* that the relationship is a "supply function" for teachers. Rather district hiring and retention practices are an important element in the labor market for teachers. This issue, made forcefully in a set of recent analyses (Ballou and Podgursky 1995, 1997 and Ballou 1996), is very important because it frames the interpretation of movements observed in the market. For example, the observation that retention and salaries are negatively related (controlling for all compensating differentials) is consistent with a positively sloped supply curve and a positive relationship between salaries and the probability that districts will not rehire teachers.

In this paper we describe changes in salary for district switchers in addition to the analysis of the probability teachers exit schools. The fact that we do not observed whether a teacher's actions are initiated by the teacher or the district does affect the interpretation of the results. It is doubtful that pay increases or improvements in non-pecuniary factors would be as large for involuntary as for voluntary job changers, therefore the observed changes in salaries and other characteristics for school changers should understate the gains of those who choose to change schools. Similarly, the link between the probability of quitting

and salaries should be more negative than that between the probability of being fired and salaries; again the estimated link between quitting and salaries should underestimate the supply relationship.

The Texas Database

The ability to understand the character and outcomes of teacher labor market activities derives from the unique data base developed under the UTD Texas Schools Project. Working with the Texas Education Agency (TEA), this project has combined different data sources to compile matched panel data sets on students and teachers. The samples contain the universe of Texas public school teachers in each year along with entire cohorts of Texas students that permit accurate descriptions of the schools of each teacher's employment.

The Public Education Information Management System, TEA's state-wide educational data base, reports key demographic data including race, ethnicity and gender for both students and teachers as well as student eligibility for a subsidized lunch. It also contains detailed annual information on teacher experience, salary, education, class size, grade, population served and subject. Importantly, this data base can be merged with information on both student and teacher achievement. Beginning in 1993, the Texas Assessment of Academic Skills (TAAS) was administered each spring to eligible students enrolled in grades three through eight.[5] These criterion referenced tests, which evaluate student mastery of grade-specific subject matter, are merged with the student and teacher information.[6]

Empirical salary schedules are constructed for each school district using the teacher microdata for the years 1993 to 1996. Emphasis on district schedules reflects our interest in the effects of shifts in salary

[5]Many special education and limited English proficient students are exempted from the tests, as are other students for whom the test would not be educationally appropriate. In each year roughly 15 percent of students do not take the tests, either because of an exemption or because of repeated absences on testing days.

[6]Reading and math tests each contain approximately 50 questions, although the number of questions and average percent correctly answered varies across time and grades. We transform all test results into standardized scores with a mean of zero and variance equal to one for each grade and year. Thus, our achievement measures describe students in terms of their relative position in the overall state performance distribution.

schedules. Each district's constructed salary schedule corresponds to the median salary of primary school teachers for the first ten single years of experience for all regular teachers without advanced degrees. The detailed panel data for each district and for individual teachers permit an unusual opportunity to address concerns about measurement error.[7]

[7]The panel data provide the opportunity to detect and correct errors in ways not generally possible in prior work. We first employ median salaries because of concerns about coding errors leading to extreme values in salary. Further, we examined each district that experienced nominal median salary decreases either over time at any level of experience or across higher experience categories in any given year. We excluded individual teachers whose salary observations appeared to be unreflective of base salaries, but, if it was not possible to detect obvious errors, the district/experience/year cell was coded as missing. There was also substantial error in the teacher experience variable, exemplified by inconsistencies in reported experience for individual teachers tracked annually. If a single year did not conform to an otherwise consistent string for an individual teacher, reported experience for that year was changed. Otherwise, reported experience was left unchanged. Error was also introduced by inconsistencies in district adjustments for part time teachers, and obvious mistakes were corrected. The cells for graduate degrees and for years of experience above ten become too thin in many districts to provide reliable salary information.

The salary information excludes a variety of special pay provisions for individual teachers. Districts offer a variety of individual extra pay opportunities, generally involving extra duties. Over 85 percent of the observed teachers receive no extra pay, and the median for those receiving it is approximately $1,000. (Given the errors in reporting the salary data, however, our base pay measure may well include some portion of extra pay). While we do not address these issues here, it is possible that some districts regularly and openly reward individual teachers or groups of teachers through extra pay channels. In such a case, extra pay may provide additional incentives affecting labor market behavior. For 90 percent of all districts, less than a quarter of all teachers receive any extra pay. Nonetheless, for 3½ percent of the Texas districts, over half of the teachers receive some extra pay.

Teacher Mobility, Salaries and Student Demographics

While teacher quality is known to be a primary determinant of student achievement, there is substantial uncertainty about the leverage that a school district has to improve the stock and performance of its teachers through compensation, class size and other non-pecuniary job characteristics. We begin with an analysis of the patterns of teacher moves in order to sort out the relative attractiveness of different districts.

Transitions Between and Within Districts (1993-96)

A primary goal of our mobility analyses is to sort out the separate influences of salary and other determinants of job attractiveness. Teachers are observed moving within districts, between districts, and out of Texas public schools entirely annually between 1993 and 1996. Importantly, we have information about salaries and student characteristics for both the sending and receiving schools for each transition.

Overall on an annual basis 79 percent of teachers remain in the same school, 14 percent exit Texas public schools, 4 percent change schools within districts, and 3 percent switch districts each year. This mobility is somewhat higher than national averages which indicate that 86 percent of all teachers remained in the same school, while only 6.6 percent left teaching between 1994 and 1995 (U.S.

Department of Education, 1997). Part of the discrepancy is explicable. Our calculations for exiting from Texas public schools include people leaving teaching plus people teaching either in private schools or outside of the state. Moreover, the rapid growth over this period of the Texas student population and the Texas economy in general undoubtedly influence teacher movements.

Similar to job turnover patterns for the labor market as a whole, transitions differ sharply by teacher experience. Table 1 indicates that mobility is much higher among probationary teachers (0-2 years of experience), who are almost twice as likely as prime age teachers (11-30 years experience) to exit Texas public schools and over four times as likely to switch districts. As expected, mobility picks up again as teachers near retirement age, and almost one-fourth of teachers with over thirty years of experience leave the Texas public schools each year. The national patterns of mobility across experience categories do follow a similar pattern to that in Texas.

The pattern of moves tends to contradict the conventional wisdom that large urban districts are the proving ground for teachers, who move to suburban jobs when possible. Table 2, restricted to those changing districts, provides only weak support for the belief that teachers commonly leave urban districts for suburban positions. Among teachers in large urban districts, most of those switching districts relocate to suburban schools, but overall less than two percent of teachers in large urban schools switch districts in each year. The absolute number moving into urban districts is only slightly smaller than the number moving out. During this period the share of Texas teachers in urban districts increased, implying that the small net outflow of teachers from urban districts is not simply a reflection of changes in the distribution of teaching positions across community types.

The bottom panel of Table 2 shows that a very similar pattern of movement holds for the sub-sample of probationary teachers, where again the net outflow from urban districts is small. Overall, probationary urban teachers are only one percentage point less likely to remain in the same school as probationary suburban teachers (71 versus 72 percent), and this is an identical gap to that for teachers of all experience levels. Two significant differences between new teachers starting in urban and starting in

Table 1. Year-to-year Transitions of Teachers by Experience, 1993-1996

Teacher Experience	Percent of Teachers Who remain in same school	change schools within same district	switch districts	exit Texas public schools	Number of teachers
0-2 years	71.2	5.0	5.8	18.0	73,261
3-5 years	75.1	4.8	4.1	15.9	55,072
6-10 years	79.2	4.6	2.8	13.5	60,831
11-30 years	84.0	3.9	1.4	10.8	166,487
>30 years	72.8	2.4	0.4	24.4	7,207
All	79.1	4.3	2.9	13.7	376,078

Table 2. Destination Community Type for Teachers Changing Districts, by Origin Community Type and Teacher Experience Level

Origin Community Type and Teacher Experience	% of Teachers Who Move to				Number Teachers Changing Districts	Percent of origin teachers	Change in share of teachers by community type 1993-1996
	Rural	Large Urban	Small Urban	Suburban			
I. All Teachers							
Rural	63.4	4.6	7.8	24.2	4,529	3.6	-0.8
Large Urban	20.8	11.6	9.6	58.0	1,359	1.9	0.8
Small Urban	28.8	10.6	12.8	47.8	1,184	2.4	-0.2
Suburban	24.4	12.9	12.3	50.5	3,786	2.7	0.0
II. Probationary Teachers (0-2 yrs experience)							
Rural	58.5	5.3	8.1	28.1	1,803	8.0	-1.7
Large Urban	16.4	11.2	10.6	61.7	517	3.8	2.1
Small Urban	25.3	11.8	13.2	49.7	509	5.2	-0.9
Suburban	21.0	14.5	11.7	52.8	1,450	5.3	0.5

suburban districts do exist: Probationary urban teachers are roughly 3.5 percentage points more likely to exit teaching than those in suburban districts (not shown), while probationary suburban teachers are somewhat more likely simply to switch schools within districts.

Movement from rural districts follows a very distinct pattern. The majority of movers goes to a different rural district. Significantly fewer rural teachers move to urban districts than is the case for teachers initially in urban or suburban districts.

These aggregate transition rates among community types provide no information on the actual changes in salary and student composition. Tables 3, 4 and 5 report in increasing detail the relationship between pre-move and post-move salaries and student characteristics for teachers who switch schools and districts. Each table concentrates on how the average of specific characteristics (C) change with a move from district d to district d', calculated across all teachers who move as

(2)

where year t is the first year in the new district. In other words, □C is the change in characteristics between sending and receiving schools calculated in the year of move.

The salary changes are computed by single years of experience. For example, the salary change for a moving teacher with four years of experience equals the district average salary of 5th year teachers in the new district minus the district average salary of 5th year teachers in the old district, both calculated in the year of the change. Because consistent salary schedule information is only available for teachers with ten or fewer years of experience, all teachers with more experience are excluded from these tables. (Roughly three-fourths of teachers switching districts have less than 10 years of experience).

Table 3 reports change in salaries and district average student demographic characteristics by experience and gender. The top panel indicates that on average probationary teachers who move improve their salaries relative to what they would have earned in the initial district. Men gain 1.4 percent in salary

Table 3. Average Change in Salary and Student Characteristics for Teachers Changing Districts, by Gender and Experience

	men			women			all
	0-2 years experience	3-5 years experience	6-9 years experience	0-2 years experience	3-5 years experience	6-9 years experience	0-9 years experience
log base year salary	0.014 (0.004)	0.009 (0.005)	-0.003 (0.007)	0.007 (0.002)	-0.002 (0.002)	-0.002 (0.002)	0.004 (0.001)
Adjusted Salary[a]	0.013 (0.003)	0.020 (0.004)	-0.002 (0.006)	0.007 (0.001)	0.004 (0.002)	-0.002 (0.002)	0.006 (0.001)
District Average Student Characteristics							
Average Test Score[b]	0.064 (0.01)	0.074 (0.02)	0.036 (0.02)	0.087 (0.01)	0.092 (0.01)	0.075 (0.01)	0.080 (0.00)
% Hispanic	-6.0 (1.0)	-6.2 (1.5)	-2.3 (1.8)	-5.2 (0.4)	-5.3 (0.6)	-4.2 (0.6)	-5.0 (0.3)
% Black	-5.0 (0.6)	-2.2 (0.9)	0.5 (1.1)	-2.8 (0.3)	-2.9 (0.4)	-2.9 (0.4)	-2.6 (0.2)
% Subsidized Lunch	-6.0 (0.9)	-5.3 (1.5)	-2.4 (1.7)	-7.3 (0.4)	-2.4 (0.6)	-6.1 (0.6)	-6.6 (0.3)

Notes: a. Adjusted salary is residual of log salary by district and experience level on 19 regional indicators, 3 community type, indicators, the district average test score, and the district average percentage black, Hispanic, and low income.
b. District average of mathematics and reading score on TAAS exams, normalized to mean zero and standard deviation one.

with a move, while women gain half that amount.[8] The average salary gain declines with experience, and the difference is statistically insignificant for more experienced teachers.[9] The gain averaged across all movers with less than ten years of experience is 0.4 percent of annual salary at the time of the move.

Because compensating differentials could conceal the true change in salary holding other factors constant, we attempt to control for other determinants of teacher labor supply. Log salary at each experience level is regressed on 19 region dummies, 3 community type dummies, the district average achievement score, and the district average percentages of Black, Hispanic and low income students.[10] The residuals from these regressions provide salary measures adjusted for differences in working conditions, amenities and local labor markets. Consistent with the existence of compensating differentials, the second row of Table 3 shows that average adjusted salaries increase by 50 percent more than raw salaries (0.6 percent versus 0.4 percent), though there is substantial variation in the pattern of results across experience and gender.

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[8]Because women are more likely to be married or have children than men of the same age, the smaller gains of women may reflect the fact that more transitions are precipitated by family considerations. However, we have no information on reason for moving or family status.

[9]We present the analysis in terms of teacher experience, but tenure within the district may also have separate implications for salary and other factors that affect satisfaction and mobility.

[10]The achievement score is the average of math and reading scores. These regressions explain about 60 percent of the raw variance in log salaries, and the district student characteristics are significantly related to salaries. Standard errors in the tables have not been adjusted for the fact that these are residuals.

In contrast to the modest changes in salary, the bottom panel of Table 3 provides strong evidence that teachers systematically favor higher achieving, non-minority, non-low income students. The findings for achievement are the clearest and most consistent across gender and experience categories, showing that the district average achievement rises by roughly .08 standard deviations, or three percentile points on the state distribution, for the average mover. The percentages black, Hispanic and eligible for a subsidized lunch also decline significantly for movers. Although there is variation across experience categories, black and Hispanic compositions of districts decline by 2.5 and 5 percent, respectively, and the percent eligible for free or reduced lunch falls by 6.6 percent.

The average changes, however, mask considerable heterogeneity, some of which appears to be systematically related to origin and destination community types. For example, the strongest support for presence of compensating differentials comes from teachers who move among urban and suburban districts. Table 4, which characterizes moves by different types, shows that teachers who move from large urban to suburban schools experience average nominal salary *losses* of 0.65 percent but average adjusted salary *increases* of 1.4 percent.[11] Similarly, the adjusted salary increase is three times as large as the raw salary increase for teachers who switch among suburban districts.

Similar to the pattern for salaries, Table 4 reveals dramatic changes in district average student characteristics for teachers who move from urban to suburban districts, including a 0.35 standard deviation (14 percentile) rise in average achievement and falls in racial and ethnic concentrations of 15-20 percent. Perhaps more surprising, teachers who move among suburban districts also experience similar, albeit smaller, changes in student characteristics than found in the urban-suburban moves: district average achievement rises by more than one tenth of a standard deviation, and the percentages Black, Hispanic and eligible for a subsidized lunch all decline.

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[11]The residual salaries control for interregional price differences but not for intraregional differences such as commonly observed housing price gradients. Thus, these estimates quite likely understate the fully compensated differences in salary.

Table 4. Average Change in Salary and in District and Campus Student Characteristics for Teachers with 0-9 Years of Experience who Change Districts, by Community Type of Origin and Destination District

	District Average Characteristics		Campus Average Characteristics	
	large urban to suburban	suburban to suburban	large urban to suburban	suburban to suburban
log base year salary	-0.0065 (0.0024)	0.0021 (0.0019)		
Adjusted Log	0.014 (0.002)	0.006 (0.002)		
Average Student Characteristics				
Average Test Score[b]	0.35 (0.01)	0.12 (0.01)	0.34 (0.02)	0.13 (0.01)
% Hispanic	-18.8 (0.9)	-7.0 (0.6)	-19.0 (1.4)	-5.3 (0.8)
% Black	-15.1 (0.6)	-4.1 (0.4)	-15.5 (1.3)	-3.4 (0.8)
% Subsidized Lunch	-23.9 (0.9)	-9.5 (0.6)	-24.3 (1.3)	-9.6 (0.7)

The right hand side of Table 4 calculates the changes in campus average student characteristics rather than district averages. Changes in campus characteristics provide information on the extent to which district switchers tend to move to schools in particular parts of the district achievement or student demographic distributions. These changes also highlight any systematic changes in student characteristics for teachers who switch schools within districts.

There is little evidence from Table 4 that teachers who move from urban to suburban districts experience changes that exceed the differential between district averages. In other words, urban-suburban movers appear to retain their same relative position in the two districts. On the other hand, teachers who move within urban districts experience a substantial increase in average achievement and a decline in percent minority and percent eligible for a subsidized lunch. Those who choose to switch schools within urban districts appear to seek out schools with fewer academically and economically disadvantaged students. These patterns are consistent with the frequently hypothesized placement of new teachers in the most difficult teaching situations within urban districts coupled with an ability to change locations as they move up the experience ranks (cf. Raymond, Fletcher, and Luque 2001).

An important question is whether teacher preferences differ systematically on the basis of race, ethnicity or other factors. Specifically, while the typical transition increases average student achievement and reduces percent economically disadvantaged and percent nonwhite, there may be substantial differences among black, Hispanic and white teachers.

Table 5 shows distinct differences in the transition patterns of black and Hispanic teachers. Black teachers tend to move to schools with higher black enrollment shares than the schools they left, regardless of whether or not they change districts. On the other hand, the average change in percent Hispanic for

Table 5. Average Change in Salary and in District and Campus Student Characteristics for Black and Hispanic Teachers with 0-9 Years of Experience who Change Campuses

	Between district moves		Within district moves	
	black teachers	Hispanic	black teachers	Hispanic
Average Test Score[b]	-0.01 (0.03)	0.02 (0.01)	0.01 (0.02)	0.03 (0.01)
% Hispanic	-5.0 (1.9)	-5.5 (0.9)	-6.0 (1.4)	-2.8 (0.5)
% Black	5.8 (2.5)	0.2 (0.5)	3.8 (1.6)	-0.7 (0.4)
% Subsidized Lunch	-1.3 (1.9)	-4.9 (0.8)	-4.0 (1.1)	-5.3 (0.6)
No. teachers moving	254	1,207	464	1,360

Hispanic teachers is quite similar in direction and magnitude to the changes experienced by teachers as a whole.[12] In addition, the change in average test scores is much smaller for black and Hispanic teachers.

It is difficult to disentangle the possible underlying mechanisms for this race/ethnic pattern in mover outcomes. It may reflect differences in teacher preferences, or it may emanate from very different preferences for factors related to race or ethnicity. For example, if there is extensive residential segregation and teachers prefer to work closer to where they live, blacks may rank predominantly black schools much more highly than Hispanic and white colleagues, other things equal.

Of course differences by teacher ethnicity may not be driven entirely by teacher preferences. There is no way to quantify the extent to which district personnel policies contribute to the systematic differences observed in Table 5. For example, if school and district opportunities for black teachers were dependent on their willingness to teach in schools with higher proportions of black students, patterns such as these could easily result.

To summarize the effects on students, Table 6 reports simple school average transition rates at different points in the distribution of school and district characteristics. The table shows that teachers in schools in the top quartile of adjusted salaries are 3 percentage points less likely to exit the public schools and almost 1 percentage point less likely to switch districts than teachers in the bottom quartile schools.

[12]We look at annual changes, but Kain and Singleton (1996) show that these moving patterns accumulate and interact with new hiring to produce significant differences in teacher characteristics for Black and white students, even across campuses within individual districts.

Table 6. School Average Transition Rates by Distribution of Residual Teacher Salary and Student Demographic Characteristics (data weighted by number of teachers in school)

quartile of distribution	Probability teachers move to new school	Probability teachers move to new district	Probability teachers exit public schools
Residual Salary			
lowest		3.3%	16.7%
2nd		3.2%	14.7%
3rd		2.8%	14.2%
highest		2.5%	13.7%
Average test score			
lowest	4.4%	3.4%	17.4%
2nd	3.8%	3.6%	15.0%
3rd	3.2%	3.0%	14.1%
highest	3.3%	2.5%	12.7%
% elig for free lunch			
lowest	3.8%	2.3%	12.8%
2nd	3.0%	3.3%	14.7%
3rd	3.4%	3.7%	15.0%
highest	4.7%	3.0%	16.6%
% Black			
lowest	3.4%	3.6%	16.2%
2nd	3.7%	2.7%	13.4%
3rd	3.6%	2.8%	13.6%
highest	4.1%	3.3%	15.8%
% Hispanic			
lowest	3.3%	3.1%	14.1%
2nd	3.8%	3.1%	14.3%
3rd	3.5%	3.2%	14.7%
highest	4.3%	3.1%	16.5%

Note: The quartile divisions are calculated using the number of teachers as weights for the size of each school. Differences in average class sizes imply that these weights do not exactly capture enrollment differences, but data on enrollment were not available for all schools in all years.

The most dramatic differences in school transition rates are related to student achievement. Teacher transition rates for schools in the bottom achievement quartile are much higher than those in the top quartile. Over 25 percent of teachers in the bottom quartile schools leave each year, while in the top quartile schools less than 20 percent leave. The largest difference is in the probability of exiting public schools entirely. These differences imply that the lowest achieving students are more likely to have teachers new to the school and to the profession, and evidence from Texas strongly suggests that this will adversely affect achievement (Rivkin, Hanushek, and Kain, 2001).[13]

Transition Regressions

The previous descriptive information on moves does not take into account the joint effects of the various influences. Table 7 presents reduced form estimates for linear probability models of the probability of leaving a district (either switching districts or exiting from the Texas public schools) as a function of the combined teacher and district characteristics. Separate estimates are computed by experience categories in order to allow for differences in preferences, family circumstances and job security. In particular, those at higher experience levels have chosen for the most part to remain in their current district for a number of years regardless of district characteristics, which would tend to reduce the link between transition probabilities and the included district characteristics. In addition, the estimated relationship between transitions and percentages black and Hispanic are allowed to vary by teacher race and ethnicity.

[13]Note that a portion of the observed differential could reflect the fact that schools with a lot of teachers exiting tend to have more probationary teachers (who on average do worse in the classroom). The magnitude to these effects, however, is insufficient to lead to the overall results here (Rivkin, Hanushek, and Kain 2001).

Table 7. Estimated Effects of Starting Teacher Salary and Student Demographic Characteristics on the Probability that Teachers Leave School Districts, by Experience
(linear probability models with and without district fixed effects, absolute value of huber-white adjusted t statistics in parentheses)

	Experience				
	0-2 yrs	3-5 yrs	6-10 yrs	11-30 yrs	>30 years
1. No District Fixed Effects					
log first year salary	-0.26	-0.14	-0.06	-0.09	0.10
	(6.40)	(2.94)	(1.50)	(2.74)	(0.63)
Campus Average Student Characteristics					
Test Score	-0.035	-0.042	-0.045	-0.033	-0.053
	(3.85)	(4.63)	(5.13)	(5.16)	(1.91)
% elig. for subs lunch	0.00	-0.04	0.00	0.03	-0.01
	(0.18)	(1.49)	(0.16)	(1.15)	(0.13)
% Black	0.13	0.09	0.03	0.02	-0.09
	(5.49)	(3.59)	(1.23)	(0.86)	(1.41)
% Hispanic	0.04	0.05	0.00	-0.01	-0.07
	(1.32)	(1.73)	(0.06)	(0.43)	(1.06)
Interactions					
Black * % Black	-0.26	-0.18	-0.11	-0.08	0.08
	(7.31)	(4.84)	(3.88)	(5.14)	(1.34)
Black * % Hispanic	-0.14	-0.04	-0.06	-0.06	0.10
	(3.49)	(1.01)	(2.31)	(4.09)	(1.62)
Hispanic * % Black	-0.15	-0.04	-0.03	-0.07	0.38
	(3.33)	(0.81)	(0.61)	(2.11)	(1.68)
Hispanic * % Hispanic	-0.12	-0.08	-0.07	-0.06	0.07
	(4.56)	(2.93)	(2.52)	(3.65)	(0.76)

Table 7 (continued)

	Experience				
	0-2 yrs	3-5 yrs	6-10 yrs	11-30 yrs	>30 years
2. District Fixed Effects					
log base year salary	-0.09 (1.14)	-0.14 (1.20)	-0.20 (1.97)	-0.15 (1.60)	0.22 (0.65)
Campus Average Student Characteristics					
Test Score	-0.029 (2.99)	-0.034 (3.60)	-0.040 (4.45)	-0.029 (4.09)	-0.061 (2.23)
% elig. for subs lunch	-0.06 (2.72)	-0.08 (3.34)	-0.06 (2.76)	-0.01 (0.51)	-0.07 (0.97)
% Black	0.20 (7.78)	0.16 (5.94)	0.11 (5.85)	0.06 (5.26)	-0.09 (1.11)
% Hispanic	0.10 (3.60)	0.12 (3.93)	0.09 (4.17)	0.04 (2.47)	-0.03 (0.40)
Interactions					
Black * % Black	-0.27 (7.44)	-0.19 (4.88)	-0.11 (4.10)	-0.07 (4.93)	0.12 (1.65)
Black * % Hispanic	-0.15 (3.54)	-0.04 (0.97)	-0.06 (2.46)	-0.06 (4.82)	0.08 (1.15)
Hispanic * % Black	-0.16 (3.78)	-0.07 (1.49)	-0.08 (1.57)	-0.07 (2.47)	0.27 (1.08)
Hispanic * % Hispanic	-0.12 (5.04)	-0.08 (2.90)	-0.07 (2.67)	-0.06 (4.45)	-0.01 (0.12)
Observations	57,833	42,492	55,931	125,936	5,457

The specifications producing the top panel estimates do not include district fixed effects, meaning that most of the variation in salary and other characteristics comes from differences between districts. In contrast, the specification for the bottom panel includes district fixed effects. Therefore these estimates are identified by differences across time in salary and other factors within districts. By eliminating the unobserved differences in other determinants of teacher labor supply that may be correlated with the included covariates, the fixed effect specifications are much more likely to identify the link between the probability of exit and the included characteristics.

The baseline non-fixed effect estimates are qualitatively similar to the previously presented univariate statistics. Higher salaries reduce the probability of exiting a district, and the magnitude of the effect tends to decline with experience. The transition rate is also significantly related to a number of student characteristics including average achievement, percent black and percent Hispanic. Higher average student achievement significantly reduces the probability of moving or exiting Texas public schools at all levels of experience. Non-black or Hispanic teachers are more likely to transition the higher are the Black and Hispanic enrollment shares, although the only significant effects are related to percent black students for younger teachers. Exactly the opposite is true for black and Hispanic teachers, who are less likely to transition the higher the minority enrollment shares. There is little evidence of an independent effect of percent eligible for a subsidized lunch. Finally, (not shown) there is little or no evidence that the probability of moving or exiting is systematically related to average class size in any specification, raising doubts about the frequently hypothesized impact of smaller classes on teacher decisions.

The bottom panel reports results for models with district fixed-effects that remove the influence of any time invariant district factors. A comparison of the top and bottom panels demonstrates the importance of controlling for such unobserved variables. In particular, the student racial and ethnic composition coefficients for non-black, non-Hispanic teachers change markedly. Now it becomes clear that increases in the campus proportion of students who are Hispanic or black raises the probability of

exiting for these teachers, although similar to the other variables the effects tend to decline with experience. In comparison the inclusion of district fixed effects has little impact on the estimates for black and Hispanic teachers.[14]

In terms of the salary variable, the estimated effect for probationary teachers falls by roughly two thirds in magnitude following the inclusion of the fixed effects, while the estimates for teachers with six to ten years of experience increases by more than a factor of three. While the fixed effect results alone do not provide strong evidence in favor of the belief that teachers respond to salary, the consistently negative coefficients for teachers with less than thirty years of experience in combination with a similar and much more significant set of findings in the non-fixed effect specifications support the belief that higher salaries reduce exits.[15] It is quite plausible that the small salary variations across time provide a noisy measure of the longer term salary shifts that would affect decisions to quit or change schools, particularly because base year salary is a noisy representation of the entire salary structure.

Finally, the estimated effects of average student test score on the probability of leaving a district tend to fall slightly (15 to 20 percent in general) following the inclusion of the fixed effects. It appears that some other characteristic of districts is correlated with student average achievement and teacher transitions.

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[14]The inclusion of fixed effects also raises the magnitude and significance of the coefficient on eligibility for a subsidized lunch, but the direction of the effect is inconsistent with a labor supply story in which teachers prefer districts with higher income children. More likely, the negative relationship for subsidized lunch reflects institutional changes at schools related to Texas school finance reform efforts. Schools with less wealthy student populations experienced revenue increases during this period, money which may have been used to make teaching more attractive (in ways not measured here).

[15]Salary may have a much different effect on the retirement decisions for the small number of teachers with more than thirty years of experience than on the decisions of younger teachers.

The estimates reported in Table 7 restrict the effects of salary, student and classroom characteristics to have the same effects on the probability of switching schools as on the probability of leaving the Texas public schools entirely. It may be the case, however, that variable effects differ for these two transitions. In particular, teachers knowledgeable of the generally low level of salaries in the profession may be much more sensitive to salary differences among districts than between teaching and other alternatives. Consequently we divide district leavers into those who move to a new district and those who exit the Texas public schools entirely and estimate multinomial logit specifications. Again separate estimates are computed for the five experience categories.

The results in Table 8 indicate that teacher salary is much more strongly related to the probability of switching districts (relative to remaining) than to the probability of exiting the Texas public schools. This salary sensitivity for district moves holds across all experience groupings. In contrast, student achievement appears to be a much more important determinant of the probability of exiting schools. Teaching lower achieving students B whether because teachers find it more difficult or less rewarding B is strong factor in decisions to leave Texas public schools, and the magnitude of the effect holds across the full range of teacher experience.

As seen previously, teaching in racially concentrated districts has a strong effect on both the probability of leaving the public schools entirely and on the probability of switching districts. For white teachers, the influence on switching districts remains across the experience distribution, while the influence on exiting the public schools is concentrated in the earlier years. For black teachers, the reactions to varying concentrations of black students is almost exactly the opposite that for whites in both sign and magnitude.

Conclusions

The results in this paper confirm the difficulty that schools serving academically disadvantaged students have in retaining teachers, particularly those early in their careers. There is also strong evidence

Table 8. Multinomial Logit Estimated Effects of Teacher Salary and Student Demographic Characteristics on the Probabilities that Teachers Switch School Districts or Exit Teaching
(absolute value of t statistics in parentheses; remaining in the same district is the numeraire)

	Experience				
	0-2 yrs	3-5 yrs	6-10 yrs	11-30 yrs	>30 years
Switch Districts					
log base year salary	-2.05	-2.10	-1.88	-1.59	-2.87
	(6.00)	(4.54)	(3.90)	(3.53)	(0.65)
Campus Average Student Characteristics					
Test Score	-0.05	-0.40	-0.11	-0.15	-1.74
	(0.66)	(3.80)	(0.93)	(1.33)	(2.10)
% elig. for subs lunch	0.49	-0.06	0.27	0.41	0.50
	(3.06)	(0.31)	(1.17)	(1.87)	(0.30)
% Black	1.02	0.84	0.83	0.88	-1.26
	(6.35)	(3.69)	(3.33)	(3.57)	(0.61)
% Hispanic	0.10	0.49	0.26	0.19	-0.99
	(0.60)	(2.12)	(1.02)	(0.78)	(0.48)
Interactions					
Black * % Black	-2.79	-1.67	-2	-2.21	4.08
	(6.98)	(2.91)	(3.83)	(5.24)	(0.58)
Black * % Hispanic	-1.31	-0.11	-0.49	-1.62	2.82
	(2.93)	(0.20)	(0.97)	(3.65)	(0.35)
Hispanic * % Black	-1.37	-1	-0.87	-0.02	-1.25
	(3.25)	(1.70)	(1.22)	(0.03)	(0.22)
Hispanic * % Hispanic	-1.15	-1.06	-0.70	-0.81	-1.77
	(5.44)	(4.01)	(2.12)	(2.70)	(0.76)

Table 8 (continued)

	Experience				
	0-2 yrs	3-5 yrs	6-10 yrs	11-30 yrs	>30 years
Exit Teaching					
log base year salary	-1.22	-0.55	-0.06	-0.67	0.62
	(5.50)	(2.07)	(0.24)	(3.60)	(0.91)

Campus Average Student Characteristics

Test Score	-0.25	-0.24	-0.40	-0.36	-0.28
	(5.39)	(4.08)	(7.20)	(8.77)	(2.14)
% elig. for	-0.18	-0.27	-0.15	0.23	-0.06
subs lunch	(1.93)	(2.36)	(1.34)	(2.83)	(0.22)
% Black	0.59	0.45	0.13	0.13	-0.51
	(5.88)	(3.49)	(1.04)	(1.44)	(1.46)
% Hispanic	0.24	0.27	0.01	-0.08	-0.35
	(2.34)	(2.11)	(0.11)	(0.83)	(1.12)
Interactions					
Black *	-1.20	-1.10	-0.64	-0.58	0.49
% Black	(5.95)	(4.21)	(2.77)	(4.29)	(1.31)
Black *	-0.74	-0.29	-0.43	-0.48	0.56
% Hispanic	(3.18)	(1.02)	(1.73)	(3.42)	(1.61)
Hispanic *	-0.53	0.06	-0.08	-0.71	2.27
% Black	(1.92)	(0.16)	(0.23)	(2.46)	(1.56)
Hispanic *	-0.43	-0.24	-0.46	-0.61	0.52
% Hispanic	(2.87)	(1.34)	(2.65)	(4.83)	(0.84)

that non-black, non-Hispanic teachers systematically prefer non-black, non-Hispanic students, while the opposite appears to be the case for black and Hispanic teachers. These findings conform to the widely publicized teacher shortages plaguing many of the nation=s inner city schools.

A key issue is the magnitude of the additional compensation required to offset the disadvantages some schools must overcome in order to compete for teachers. We examined the possibility that the impact of salaries varied with student characteristics and the possibility that the effects of student characteristics were non-linear. We found little or no evidence of such non-linearities, therefore the salary coefficients in the tables provide the best estimates of the compensating differentials needed to offset the labor market disadvantages of certain schools.

The estimates indicate that higher salaries reduce the probability that teachers leave a district, and the magnitude of this effect tends to be fairly similar across the experience spectrum with a range from -0.1 to -0.3, implying that a ten percent salary increase (between two and three thousand dollars per year depending upon the district) would reduce exits by at most three percent. By comparison, a one standard deviation decrease in school average achievement increases the probability of exiting by between one and two percent, and a ten percent increase in the percentage of students who are black or Hispanic raises the probability that non-black, non-Hispanic teachers exit by an additional one to two percent. Consequently, schools serving a high proportion of students who are academically very disadvantaged and either black or Hispanic may have to pay an additional 20, 30 or even 50 percent more in salary than those schools serving a predominantly white or Asian, academically well-prepared student body. Of course the availability of black or hispanic teachers may substantially reduce the costs of hiring for these schools.[16]

[16]The ability to attract minority teachers over time has diminished (National Center for Education Statistics 2000) and has been the subject of previous attention to teacher supply (Murnane et al., 1991; Hanushek and Pace 1995).

Importantly, the pattern of multinomial logit estimates suggests that across the board salary increases are unlikely to compensate for the labor market disadvantages facing some schools. It appears that salaries relative to other districts rather than the absolute level of teacher salaries is the important factor, as salaries appear to have a larger impact on the probability of switching districts rather than exiting teaching altogether. Of course the absolute level of salaries may affect the number of prospective teachers, but that is beyond the scope of this work.

An alternative to raising salaries is the abatement of the disadvantage associated with particular types of students. If the results capture teacher preferences for student race or ethnicity then districts possess few policy options. But these estimates may well proxy for other factors such as safety or travel time to work related to these characteristics. In addition, improvements in academic preparation through better preschools or child care services may well have the indirect benefit of making schools more appealing to prospective teachers. Learning more about the precise sources of the relationship between teacher labor supply and the specific student characteristics would provide important, policy relevant information.

Finally, this paper focuses solely on the quantity of teacher transitions with little or no attention paid to quality. The actual cost of improving the quality of instruction depends crucially on the details of district hiring, retention and other personnel policies. Ballou (1997) raises serious doubts that districts systematically hire the best candidates available, suggesting that instructional quality could be improved at little or no cost in terms of higher salary. The extent to which better personnel policies would merely reallocate teachers among schools rather than raise the overall average level of instruction is an extremely important issue that merits further research.

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Appendix Table A1. Descriptive Statistics C Means and Standard Deviations

	4th Grade	5th Grade
Achievement Gains		
Math	-0.02	0.01
	(0.65)	(0.59)
Reading	-0.03	0.01
	(0.67)	(0.63)
Log District Salary		
0 yrs experience	10.00	10.00
	(0.11)	(0.10)
Teacher Experience Distribution		
% 0 years	6.2	5.7
%1 year	5.8	5.8
% 2 years	5.1	5.6
% 3-4 years	11.7	10.8
% 5-9 years	21.4	19.7
% 10-19 years	30.9	31.0
% 21-30 years	16.4	18.6
% > 30 years	2.5	2.8
Teacher Transition Distribution from Prior Year		
% same campus & grade	67.6	66.8
% same campus, different grade	12.8	11.6
% different campus, same district	4.2	5.6
% different district	3.6	3.3
% not in Texas public schools	11.7	12.7
Student Demographic Characteristics		
% Black	14.1	14.0
	(20.4)	(20.4)
% Hispanic	31.0	31.0
	(30.0)	(30.2)
% Eligible for subsidized lunch	46.8	46.7
	(27.1)	(27.0)

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